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EFFECTS OF WATER TEMPERATURE,
COOSA RIVER - WEISS IMPOUNDMENT,
ALABAMA - GEORGIA

Federal Water Pollution Control Administration
Atlanta, Georgia

December 1967

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REPORT ON
EFFECTS OF WATER TEMPERATURE
COOSA RIVER - WEISS IMPOUNDMENT

Southeastern Region
Federal Water Pollution Control Administration
Athens, Georgia

December 1967

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EFFECTS OF WATER TEMPERATURE
COOSA RIVER - WEISS IMPOUNDMENT

Introduction:

At the Conference concerning interstate pollution of the Coosa River and its tributaries held on August 27, 1963, it was determined that untreated and inadequately treated sewage and industrial wastes discharged to the Coosa River, in the reach between Rome, Georgia, and the Georgia-Alabama state line polluted this interstate reach of the Coosa River in Georgia and Alabama. These waste discharges lowered the dissolved oxygen content of parts of this reach below the 4 parts per million (ppm) which is considered essential for the support of a suitable warm water sport fishery. The Conference Summary requires that all polluters install secondary treatment for removal of wastes. When the required waste treatment facilities are in operation, pollutional discharges to this stretch will have been reduced from a total of 87,000 pounds per day of 5-day B.O.D. to approximately 27,000 lbs./day.

The problem of water quality is compounded, however, by factors other than organic waste discharges. There are low river flows caused by regulation of the Etowah River at Alatoona Reservoir. The organic wastes from Georgia Kraft pulp and paper manufacturers, which represent the major pollutional load, are discharged to the headwaters of the Weiss impoundment. The lower velocity and increased depth which result from this impoundment reduce the natural reaeration capacity of the

Coosa River and retard the recovery of the river to suitable levels of dissolved oxygen. In addition, water temperatures in the Weiss impoundment are higher than would occur in a natural free-flowing regime primarily due to absorption of solar radiation. Heat is also added by the discharge of used cooling water from the Georgia Power Company's Plant Hammond facility at a point just upstream of Georgia Kraft. Higher temperature increases the rate of oxygen utilization by bacteria in decomposing organic material thereby causing a more rapid depletion of oxygen in the receiving waters. It also contributes to stratification of the waters of the impoundment. Because of these complicating physical conditions, the provision of a minimum D.O. of 4 ppm cannot be met by normal secondary treatment alone. A combination of high water temperature, pollutional discharges and low river flow has a synergistic effect in inhibiting the desired use of this part of the Coosa River for a warm water sport fishery.

Effects of Water Temperature:

Previous evaluations have concluded that to meet waste loading demands in the Coosa River when the present abatement program is completed, a minimum flow of 2,000 cfs will be required to guarantee a minimum D.O. of 4 ppm. (1)(2)(3) These evaluations were based on the average daily water temperature of 79°F during August in the free-flowing section of the Coosa River. However, the addition of heat load to the impoundment section by solar radiation and cooling water causes temperatures which are higher than that observed in un-impounded

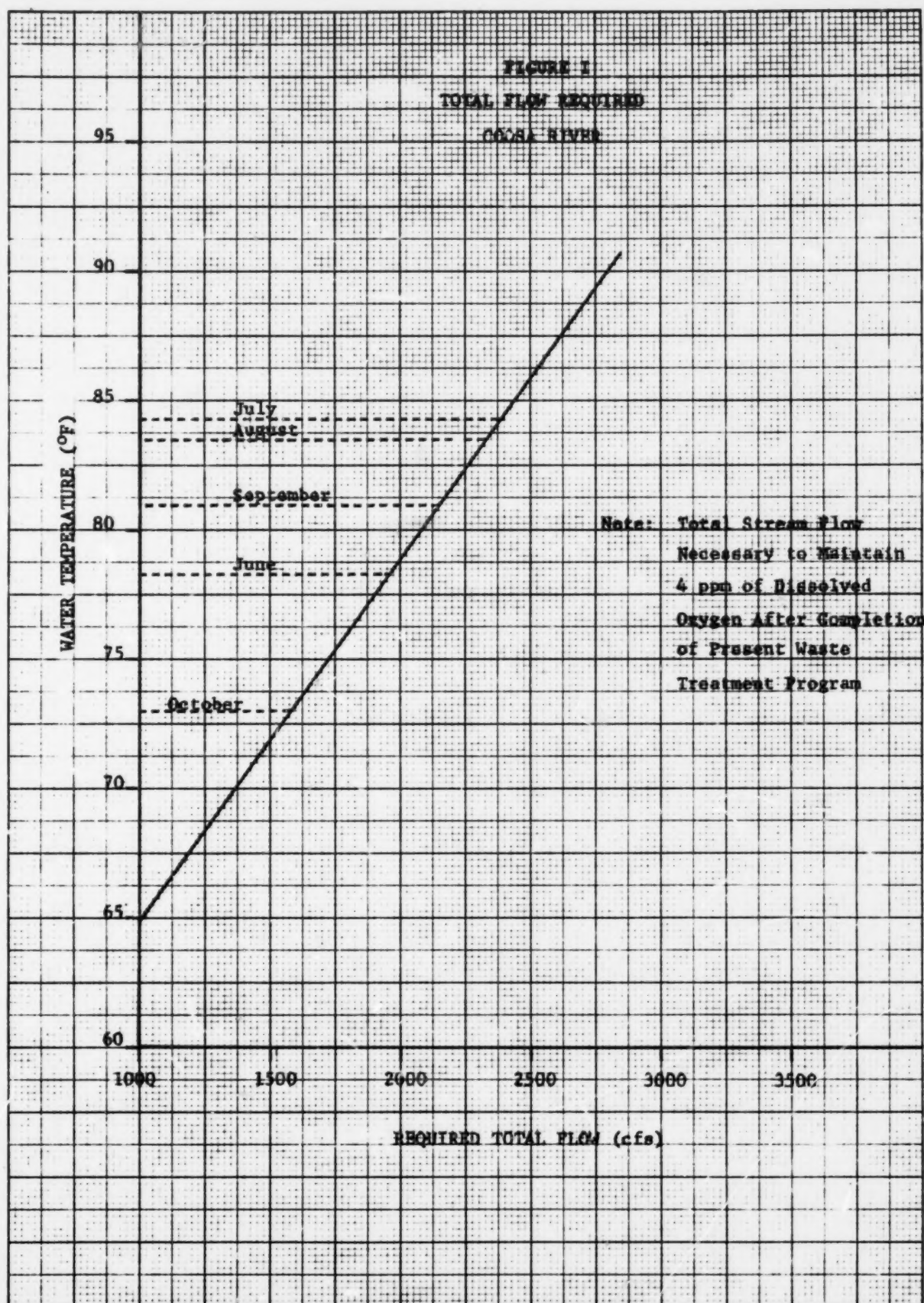
stretches. To ascertain the expected water temperature in the Weiss impoundment, data collected over the past two years at the Georgia-Alabama state line were analyzed. A summary of these data is presented in Table I for the expected daily water temperatures in June, July, August, September and October. The values for October are for the first half of the month only since the reservoir cools very rapidly during the latter half. These temperatures are generally higher at the 10% probability level than those used in the previous supplemental flow analyses. Therefore, either (1) a greater supplemental flow is required or, (2) increased waste removals must be considered to maintain a minimum D.O. of 4 ppm or, (3) the artificial heat load must be reduced. To insure that water quality will be adequate at least 90% of the time, the temperature which is exceeded 10% of the time will be used as the critical temperature for evaluating the necessary supplemental flow or additional waste removals. These temperatures are 78.3°F for June; 84.3°F for July; 83.5°F for August; 80.4°F for September; and 73°F for October.

Based on these temperatures and the projected treated waste loads totaling 25,000 lbs./day of 5-day B.O.D., the total flow in the Coosa River to maintain a minimum D.O. of 4 ppm was evaluated. This analysis assumes an unstratified river condition. Figure I shows the total flow required vs. temperature. Table II summarizes this figure and indicates the number of days in each month, based on previous flow records, that river flow will be less than necessary to maintain the required dissolved oxygen level and supplemental augmentation will be required. On an

TABLE I
EXPECTED WATER TEMPERATURES
WEISS IMPOUNDMENT
GEORGIA-ALABAMA STATE LINE

MONTH	MEAN	TEMPERATURES °F
		EXCEEDED 10% OF TIME
June	74.4	78.3
July	81.0	84.3
August	81.3	83.5
September	78.9	80.9
October*	71.0	73.0

*Only to October 15



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TABLE II
COOSA RIVER REQUIRED FLOWS*
MINIMUM D. O. = 4 PPM

MONTH	WATER TEMPERATURE °F	TOTAL DAILY FLOW (cfs)	NO. OF DAYS SUPPLEMENTAL FLOW NECESSARY
June	78.3	1950	0
July	84.3	2400	1.5
August	83.5	2300	8.0
September	80.9	2150	10.0
October**	73.0	1600	1.5

TABLE III
DAILY SUPPLEMENTAL FLOW REQUIRED IN CFS

MONTH	MEAN	VALUE EXCEEDED 10% OF TIME
July	300	900
August	300	640
September	600	800
October**	230	280

*This table is based on an examination of daily flow during the 1963, 1964, 1965 water years.

**To October 15.

overall basis, flow augmentation will be necessary on approximately 21 days during the period of June through October. This ranges from a high value of 10 days during September to no augmentation during June.

To estimate the amount of daily supplemental flow required, a statistical analysis of the daily flows in the Coosa River during the period of June through October was made. The difference between the required flow listed in Table II and the observed daily flow is the necessary supplemental flow. These data are summarized in Table III. For example, from Table II supplemental flow will be required on 10 days in September in any given year to guarantee a total flow of 2150 cfs. From Table III, the average daily supplemental flow in September will be 600 cfs but the amount will exceed 800 cfs on 10% of the days that augmentation is required.

The necessary storage requirement based on the 10% recurrence interval is approximately 56,000 acre feet. This storage represents 11.2% of the total maximum storage contained in the Corps of Engineers Alatoona Reservoir and Carters Reservoir which is presently under construction. If the total storage were supplied in Alatoona Reservoir, the lost power revenue because of supplementary flow for waste assimilation would be about 80,000 dollars per year. It should be emphasized that less than this amount of storage will be required for flow augmentation at least 90% of the time.

The only feasible alternative to flow augmentation at the present time is to reduce waste discharges below the specified level.

The important period for evaluating effects of these continuous waste discharges is during August when the combination of low flow and higher temperature produce the most critical waste assimilation conditions. The unsupplemented 10% low daily flow for this month of 1600 cfs has been used as the available river discharge. If allowable waste discharges are assessed based on this flow, 4 ppm of D.O. will be maintained 90% of the time during August at a temperature of 83.5°F with no additional supplemental flow. Under these conditions, the total allowable waste discharge to this reach of the Coosa River is 15,500 lbs./day of 5-day B.O.D. The cost of providing the necessary additional waste removal at the Georgia Kraft Company, which discharges over 80% of the total waste load to this reach, would be \$750,000 in capital investment with an annual operating expenditure of \$120,000.

The previous analysis is based on present waste discharges when the required treatment program is completed and in operation. If any increase in organic waste loading is anticipated due to expansion of present installations or location of new sources, and if waste removal percentages are not increased, the supplemental flow must be increased and will be required a greater percentage of the time. An estimate of the total flow required for projected waste discharges in 1980 and 2015 is presented in Table IV. The future waste loads are listed in Table A-1. The amount of augmentation as well as the percent of time that it will be necessary will increase materially by 1980. This is primarily due to the projected expansion of pulp and paper production. In the absence of any augmentation, waste removals in 1980 approximating 92.5%

TABLE IV
COOSA RIVER REQUIRED FLOWS
1980 and 2015
MINIMUM D. O. = 4 PPM

MONTH	WATER TEMPERATURE OF	TOTAL DAILY FLOW cfs	NO. OF DAYS SUPPLEMENTAL FLOW IS NECESSARY
A) 1980			
June	78.3	3375	5.5
July	84.3	4075	13.0
August	83.5	4000	27.0
September	80.9	3675	27.0
October*	73.0	2800	5.0
B) 2015			
June	78.3	3525	6.5
July	84.3	4350	15.0
August	83.5	4250	28.0
September	80.9	3900	27.5
October*	73.0	2800	5.0

*Figures only to October 15.

will be required for the pulp and paper producers. Necessary waste removal will approximate 95% in 2015. If augmentation to account for present waste discharges only is supplied, the pulp and paper interests must remove 86.5% of their wastes by 1980 and 92% by 2015. These removals are predicated on the contingency that all of the expected expansion or location of new sources will occur.

Effects of Cooling Water Discharges:

Prior to the installation of a mixing and diffusing system for cooling water discharges in 1964, the Georgia Power Company effluent with a full load on the plant (300,000 KW) and a river flow of 2,000 cfs raised the temperature of the Coosa River by about 3.5° F.⁽⁴⁾ The previous analysis reflects this heat load to the river since it is based on observed temperatures during the warm weather months of 1965 and 1966. On February 3, 1967, the Georgia Power Company announced plans to expand the Plant Hammond facility from 300,000 kilowatts to 800,000 kilowatts at a cost of \$50 million.⁽⁵⁾ This expansion is expected to be fully operational by 1970. As temperatures increase, the rate of satisfaction of organic material is increased thereby causing a more rapid depletion of dissolved oxygen. In addition, without adequate control measures, the heated water, being lighter, tends to rise to the surface and prevents mixing with the lower levels. This stratification reduces the volume available for the assimilation of wastes.

The expansion of the Plant Hammond facility will inevitably mean a greater heat load discharged to the river with resulting

increased water temperatures. Cooling water requirements for power plants are about 5 million gallons per hour per 100,000 kilowatts.⁽⁶⁾ This indicates that, when the full capacity of the plant is being used for power generation, approximately 1490 cfs of cooling water will be required at Plant Hammond after the expansion. Georgia Power reports an average of 18°F rise in cooling water temperature from the intake.⁽⁴⁾ If supplemental flow is provided for organic waste discharges, a minimum of 1600 cfs will be available during October and flows as low as this value will occur 9% of the time. Assuming that the cooling water effluent is completely mixed immediately below the outfall, the increase in river water temperature would be 16.7°F. The standards of the Georgia Water Quality Control Board require that water temperatures are "...not to be increased more than 10°F above intake temperatures" for fish and aquatic life.⁽⁷⁾ To meet this standard, assuming complete mixing in the river below the outfall, a minimum flow of 2680 cfs in the Coosa River is required. River flows will be below this value approximately 9% of the time in June; 15% of the time in July; 41% of the time in August; 46% of the time in September; and 31% of the time in October. Therefore, unless some cooling process as well as diffusion to assure complete mixing is accomplished, the standard requiring no greater than a 10°F increase in temperature will be violated during periods of peak generation an average 26% of the time from June to October 15 each year with a maximum of 46% during September.

There are two alternatives to the control of the temperature problem resulting from the expansion of the Georgia Power Company plant. The first is to supply additional augmentation to guarantee a minimum low flow in the Coosa River of 2680 cfs to adequately dilute the

additional heat load. This would require additional supplemental flow beyond that necessary for organic waste assimilation of 720 cfs in June; 280 cfs in July; 380 cfs in August; 530 cfs in September; and 1080 cfs in October. Augmentation would then be necessary on an average of 38 days during the period of June to October vs. the estimate of 21 days for the present heat load being discharged. The above flows are necessary for temperature control only and are predicated on a 10°F permissible increase.

The other alternative is the installation of heat dissipation devices at Plant Hammond to remove the additional heat load caused by expansion of the generating capacity from the cooling water before discharge to the Coosa River. This will insure that the water temperature increase in the Coosa River will not exceed 10°F during the minimum low flow month of October.

Summary and Conclusions:

Due to regulated river flow above waste discharges and impoundment below, 4 ppm of dissolved oxygen necessary for the propagation and maintenance of fish life as required by the Federal enforcement conference of August 27, 1963, cannot be maintained in the Coosa River by normal secondary treatment of all wastes alone. In addition, there may be an increase in heat pollution discharged to the river due to the enlargement of the Georgia Power Company Plant Hammond installation.

The recommendations of this report are as follows:

- 1) The total flow in the Coosa River at Mayo's Bar during the warm weather months shall be not less than the following: June, 1950 cfs; July, 2400 cfs; August, 2300 cfs; September, 2150 cfs; October, 1600 cfs. Any flows which are less than these levels should be supplemented by the necessary amount after present waste treatment plans are completed.
- 2) To insure adequate supplementary flow to maintain 4 ppm of D.O. after the implementation of the present waste treatment program, the Secretary of the Interior should request the U. S. Army Corps of Engineers to provide 56,000 acre feet of storage for low flow augmentation in either the existing Alatoona Reservoir or the Carters Reservoir now under construction or the most efficacious combination of both installations.
- 3) Allowable 5-day B.O.D. waste discharges to this reach of the Coosa River should not exceed 27,000 lbs./day. When economic expansion of the area occurs, higher percentages of waste removals will be necessary to meet this allowable waste load.
- 4) Georgia Power Company should install heat dissipation devices at the Plant Hammond facility or take other equivalent measures to remove the heat load generated by the proposed increase in power capacity. Georgia Power Company should also provide for effective diffusion of the cooling water discharge to insure complete mixing and so that the effluent does not contribute to a stratified condition in the river.

REFERENCES

1. Flow Requirements - Coosa River at Rome, Georgia, P. Traina U. S. Government Memorandum, May 21, 1965.
2. Report on the Dissolved Oxygen Content and Requirements in the Interstate Reach of the Coosa River between Rome, Georgia, and the Georgia-Alabama State Line, July 1966, A. W. West, FWPCA, Cincinnati, Ohio
3. Thermal Effects on Water Quality in the Coosa River, February 1967, P. A. Krenkel, Statement to Georgia Water Quality Control Board in behalf of Georgia Kraft.
4. Comments on Draft Progress Report of the Coosa River Technical Subcommittee, August 13, 1965, Georgia Power Company.
5. Atlanta Constitution, February 3, 1967.
6. Fish and River Pollution, J. R. Erichsen Jones, Butterworths and Co., 1964.
7. Establishment of Water Quality Standards and Classifications for Interstate Waters in the State of Georgia, June 1967, Georgia Water Quality Control Board.

APPENDIX

TABLE A-1
ESTIMATED WASTE LOADS
COOSA RIVER
ROME, GEORGIA, AREA

	1965		Present Plans Completed		1980		2015	
	Unt.	Treat.	Unt.	Treat.	Unt.	Treat.	Unt.	Treat.
Rome	6.8	6.8	7.1	1.4	8.7	1.7	13.0	2.6
Miscellaneous	3.5	3.5	3.9	0.7	4.9	1.0	8.4	1.8
Celanese	3.9	3.9	4.3	2.5	5.4	2.5	9.5	2.5
Pepperell	0.8	0.8	3.4	0.9	1.1	0.2	1.9	0.4
Other Paper & Pulp	-	-	-	-	51.2	16.0)		
Rome Kraft	64.0	32.0	64.0	20.0	96.0	20.0)	256.0	38.4
Subtotal	79.0	47.0	82.7	25.5	167.3	41.4	288.8	45.7
5% (Food)	4.0	2.5	4.0	1.2	8.4	2.0	14.4	2.3
TOTAL	83.0	49.5	86.7	26.7	175.7	43.4	303.2	48.0